so, this alternate motion ought to have been noticed in the various observations which have been made upon glaciers, and this does not appear to have been the case. But, in reply to this, it may be remarked that most of the observations have only given the net movement of points on the glacier during intervals of a day or more, and therefore would not show the oscillations. Again, such observations have always been at points near the end of a glacier. Now the variations in temperature of a glacier will be very different at different parts, and the motion of the end of the glacier will, to a great extent, show the average result of these different advances and retreats in different parts of the higher regions. This average result will, of course, be a steady progression down the valley, and the oscillatory movement at the end of the glacier may be so much masked by this as not to be readily observable. Lastly, it may be suggested as possible that a certain amount of expansion by heat may have the effect of giving a *set* to ice, so that it does not return to its original length when brought back to the same temperature. If this be so, the oscillations would be much less marked, and at the end of the glacier would probably be indistinguishable.

I may now draw attention to some phenomena of glacier action, which are explained by the heat theory, but which do not seem explicable on the gravitation theory.

(1.) It is well known that glaciers, when they emerge from a narrow gorge into a comparatively wide valley, spread out into a fan shape. The Rhone glacier is a well-known instance. A still better one is a small glacier in Norway, mentioned by Prof. Sexa, which spreads out to five or six times its previous width. Now the effect of gravity, acting on a mass as a whole, is to carry it in one single direction, that of the steepest slope. The only way in which gravity can produce such a spreading out is by the parts of the glacier shearing over each other in the manner of a viscous solid. But the phenomena of ice cliffs, as mentioned above, show that ice does not spread from this cause, so that the fact seems impossible to explain by gravitation alone. On the heat theory it is, of course, perfectly easy : the expansion and contraction will take place in all directions where there is freedom to move.

(2.) Connected with this phenomenon is that of the longitudinal crevasses seen near the edges of glaciers, and particularly where they spread out in the manner just described. Now on the gravitation theory, as remarked above, the only possible explanation of a crevasse is that the ice is bending over a convex surface, and that its upper part is thus placed in a state of tension, under which it breaks. Since, on the gravitation theory, every part of a glacier is exposed to a severe pressure from behind, this explanation does not fit very well even for transverse crevasses ; but to longitudinal crevasses it is clearly inapplicable, since the bottom of a valley is seldom or never convex in the direction of its width. On the heat theory the explanation is simple. We may suppose the heat energy communicated per square foot of surface to be about the same, whether near the middle or edge of a glacier. This energy is expended in producing an expansion throughout the whole thickness of the glacier, as described above. Hence the smaller this thickness, the greater will be the amount of expansion, and the greater therefore the net motion which results. Hence the thinner parts of a glacier will always be tending to tear themselves off from the thicker, and thus longitudinal crevasses will frequently be found.

(3.) The striæ which are so marked a feature of glacier-worn rocks become more easily explained on this theory. I have seen such striæ, even in the hard hypersthene of Skye, which were a considerable fraction of an inch in depth. When we consider the enormous force necessary to plough out such a furrow in hard rock, it is almost impossible to believe that it was done by the simple passage over it, once for all, of a stone imbedded in the ice. If, however, the stone descended by a series of oscillations, so that it passed many times over the same spot, this difficulty is greatly lessened.

(4.) In conclusion I may point out that the advocates of the gravitation theory are bound to explain what becomes of the heat energy which is poured into a glacier. When the sun is shining this radiant energy is always very large, although the temperature of the air may be low. In such cases the glacier does not melt ; it is perfectly clear that it must expand, as any other solid must expand under the action of heat. If so, it seems unreasonable not to hold that the gradual descent by alternate expansion and contraction must follow, as it is known to follow in the case of other materials.

On the subject of the motion of Arctic ice, Dr. Rae, F.R.S., has kindly permitted the publication of the following particulars :—

"When in Greenland, in the autumn of 1866, I was icebound at the head of one of the fiords, and slept a couple of nights at an Eskimo's house. A glacier about half a mile distant was then in full activity, the movement of which might, I believe, have been as visible to the eye as it certainly was audible to the ear.

"My own idea is that Arctic glaciers must have a downward motion more or less during the whole year, summer and winter. I believe the alternation of heat and cold—or, I should rather say, of temperature—would of itself cause motion, especially near the upper surface.

"We know that ice 2 or 3 feet or more thick contracts very considerably in a few hours by a sudden fall of 15 or 20 degrees of temperature. I have found cracks in Lake Winnipeg 3 or 4 feet wide, formed by this cause during a single night, almost stopping our sledge journey. This gap soon freezes up. Then the weather gets milder, the ice expands, and with the new additional formation is too large for the lake, and is forced up into ridges. This process goes on at every 'cold snap,'[1] alternating with milder weather. Now supposing a glacier for 10 or more feet of its depth contracts by cold, as lake ice is known to do, it will get a series of cracks probably in its longest axis, say from inland seaward ; the first snowdrift will fill up these cracks or some of them, and this filling up will to some extent perform the same office as the freezing of the cracks in the lakes. The longitudinal extent of the glacier will be increased. A snowstorm always brings milder weather, which would expand the glacier, but as this expansion would naturally tend downhill, instead of up, the whole motion would be downwards. But even if the cracks I mention did not take place, the contraction by cold would pull the ice downhill, not up, whilst the expansion by increase of temperature would tend to *push* the glacier downhill, so that these opposite actions would produce similar effects in moving the glacier, or such part of it as could be acted upon by external temperature, downwards.

"I may also add that when a crack, however slight, is formed by contraction, the cold is admitted into the body of the glacier, and increases the contracting power or influence."

SCIENTIFIC SERIALS

Annalen der Physik und Chimie, xix., part 4.—Electrical experiments : electric pressure on solids, by G. Quincke. This paper forms a continuation to a series of experiments in electrostatics published by the author in previous numbers of the *Annalen*, under the title of "Electric Expansion." It is illustrated with twenty-six cuts, and will be followed by a communication on the resistance of insulating fluids to electric force.—On electric disturbance at contact of gases with bodies in combustion, with four illustrations, by Julius Elste and Hans Geitel. The authors arrive at the general conclusion that all flames may be regarded as streams of hot gas, which generate negative electricity in burning electrodes introduced from without, as well as in small bodies in combustion suspended in them.—On electric vibration, and more especially on the phenomena of polarisation produced by vibratory movements, with four illustrations, by A. Overbeck.—On the dependence of gases as heat conductors on the state of the temperature, with three illustrations, by A. Winkelmann.—On the fundamental equations of E. Ketteler's theory of optics, by W. Voigt. The author shows that, so far from flowing from the principles of the doctrine of elasticity, Ketteler's fundamental equations are diametrically opposed to them.

THE *Journal de Physique* (May, 1883) contains the following original papers :—On the difference in barometrical pressure at two points in the same vertical line, by J. Jamin.—On the action of heat upon boracite and upon sulphate of potash, by E. Mallard.—On the penetration of actinic rays into the eye of man and that of vertebrates, and on their vision of ultra-violet rays, by E. de Chardonnet.—On a new apparatus for verifying the laws governing the fall of bodies, by M. Paquet.—On an experimental demonstration of the unequal velocity of the transmission of sound in gases and solids, by F. Griveaux.

[1] "Cold snap," an American term meaning a rather sudden increase of cold.

Zeitschrift für wissenschaftliche Zoologie, Bd. xxxviii. Heft 2 (April 27, 1883), contains:—Contribution to a knowledge of the infusoria, by Dr. G. Entz (Plate 8).—On the primordial skull of some mammalia, by Fred. Decker (Plate 9).—On some Cœlenterata of the South Sea, by Dr. R. v. Lendenfeld, of Melbourne, Part II.—On new Aplysinidiæ (Plates 10 to 13).—On the embryology of Hydra, by Dr. A. Korotneff (Plate 14).—On the larval development of *Phoxichilidium plumulariæ*, nov. sp., by Dr. R. v. Lendenfeld, with woodcuts.

Rendiconti of the *R. Istituto Lombardo di Scienze e Lettere*, May 10 and 17.—Preliminary inquiry into Zanardelli's proposed penal code (continued), by Prof. A. Buccellati.—On the commentaries of Gaius and the paraphrase of Theophilus, by Dr. C. Ferrini.—A few remarks on the first five sections of Ricardo's chapter on value, by Prof. E. Nazzani.—On the mortality of infants in the various provinces of Italy, by Prof. G. Sormani. The death-rate during the first month is shown to be much higher in winter than in summer, and in the northern than in the southern provinces. Thus: 50 per 1000 in Palermo, 190 in Padova, medium for the kingdom 91·9.—On the formation of the primitive line and primitive cleft in the gastrula of the Mexican axolotl, by Prof. G. Bellonci.—Alterations in the lower hollow vein aggravating hepatic cirrosis, by Prof. A. de Giovanni.—Observations on the comet of Brooks made in the Brera Observatory, Milan, by G. V. Schiaparelli.—On a deposit of fossiliferous Pliocene clay recently discovered near Taino, to the east of Angera, in Lombardy, by Prof. T. Taramelli.

SOCIETIES AND ACADEMIES

London

Linnean Society, June 21.—Prof. P. M. Duncan, F.R.S., vice-president, in the chair.—The following gentlemen were balloted for and elected Fellows of the Society, viz. Messrs. E. J. Baillie, J. Borland, K. McKean, E. C. Malan, and H. A. A. Nicholls.—A specimen of *Polyporus sulfureus* was exhibited for the Rev. A. A. Harland, obtained from the stem of a yew tree in the Cliveden Woods, Bucks.—A series of fossil fruits, &c., from Australia were shown for Dr. Charles E. Barnard; among these were species of *Phymatocaryon*, *Eisothecaryon*, *Ochthodocaryon*, *Spondylostrobus*, *Plesiocapparis*, and others.—Mr. W. T. Thiselton Dyer exhibited several interesting vegetable economic products, and made remarks thereon. Of a species of wax extracted by Mr. D. Morris of Jamaica from *Myrica microcarpa*, it was stated that while the berries are used for obtaining wax in South Africa, the West Indian fruits had not hitherto been used for this purpose. A gray, camphor-like substance, the product of *Artemisia noxa*, he mentioned as a rare example among the Compositæ; and there was a probability that this camphor was used in the production of Indian ink by the Chinese, and gave the peculiar aromatic odour to the true China ink. A rosary was shown made of fruits of *Trapa verbanensis*, De Not. (locally called Frutti de' Lago), from the Lago di Varese, Italy; also specimens of wax and candles made from *Rhus vernicifera* of Japan; the latter preparation is quite a local industry, which unfortunately is now ceasing on account of the rivalry of the cheap American oils.—The following plants were exhibited, viz., *Arnoseris pusilla* and *Hypochæris glabra*, obtained by Mr. Thomas Howse in West Surrey, and specimens of the Cheddar Pink (*Dianthus cæsius*), which had been grown freely by Mr. C. F. White on his garden wall at Ealing.—A paper on the structure of the hard parts of the Fungidæ (part 2, Lophoserinæ), was read by Prof. Duncan, and another by Mr. R. A. Rolfe of Kew, on the Selagineæ described by Linnæus, Bergius, and Thunberg.—A communication was read from Mr. H. G. Doran, on the malleus of *Rhytina stelleri*, based on a specimen obtained in the voyage of the *Vega*, and exhibited in the Swedish Department of the International Fisheries Exhibition, under the charge of Prof. Smitt of Stockholm. The author concludes that this auditory ossicle in the extinct Northern Sea Cow (*Rhytina*) is larger than in the Manatee (*Manatus*), and therefore it is the largest and bulkiest malleus to be found in the whole section of the animal kingdom where such a bone exists. In the character of its body it resembles that of the Manatee rather than that of the Dugong (*Halicore*); while in the manubrium it differs in *Rhytina* from the other Sirenia, and is far more generalised.—The following paper was taken as read, Notes on some new economic products recently received at the Royal Gardens, Kew, by W. T. Thiselton Dyer. Therein he treats of the West African indigo, the Inhambane copal, and the Ogea gum as exhibited at a previous meeting.—On the testis of *Limulus*, formed a communication from Mr. W. B. S. Benham. He describes the structures in question, noting the apparent isolation of many of the spermatic sacs, and the probability that they are not diverticula of the spermatic duct, but secondarily acquire connection therewith, the two structures being independently developed. He remarks that in no crustacean do the ducts of the generative glands form a network, whereas in the King Crab, as in the Scorpion and other Arachnids, they do.—There followed a paper on the Mollusca of H.M.S. *Challenger* (part xx.), by the Rev. R. Boog Watson. This contains a continued descriptive account of the family Bullidæ, dealing with the genera *Atys* and *Scaphander*, along with the group *Aplysiidæ*, genus *Dolabrifera*.

Zoological Society, June 5.—Osbert Salvin, F.R.S., vice-president, in the chair.—Mr. Sclater exhibited and made remarks on two birds obtained near Lima by Prof. W. Nation, C.M.Z.S., and on a collection of birds made in New Britain, New Ireland, and the Solomon Islands, that has been sent to him for examination by the Rev. George Brown, C.M.Z.S.—Mr. Sclater also called the attention of the meeting to a Condor from Peru, living in the Society's Gardens since 1877, which he was induced to believe was a specimen of the "*Condor pardo*," or *Sarcorhamphus æquatorialis*, Sharpe.—Mr. G. French Angas exhibited a collection of butterflies made during a recent visit to the island of Dominica, W.I.—A communication was read from Prof. Owen, C.B., entitled "Embryological Testimony to General Homology."—A communication was read from the Rev. O. P. Cambridge on some new genera and species of spiders. Eight spiders, representing as many new genera, were described: two of them belonged to the family Theraphoridæ, one to the Drasiidæ, and the others to the Thomisidæ. Three of these species were from Ceylon, three from Caffraria, one from New Zealand, and one from California.—A communication was read from Mr. A. G. Butler containing an account of the Lepidoptera collected by Mr. H. O. Forbes in the islands of the Timor-Laut group. Examples of twenty-three species were obtained.—A communication was read from Mr. Herbert Druce containing descriptions of some new species of moths of the families Zygænidæ and Arctiidæ, mostly collected in Ecuador by Mr. C. Buckley. The number of new species described was fifty, belonging to twenty-four genera.—A paper was read by Messrs. Godman and Salvin, containing remarks on the variations of certain species of butterflies of the genus *Agrias*.—Mr. G. A. Boulenger read a report on a collection of reptiles and Batrachians from the Timor-Laut group of islands, formed by Mr. H. O. Forbes. Two new species were described—the one a lizard of the Australian genus *Lophognathus*, and the other a snake of the Indian genus *Simotes*, propo ed to be named respectively *L. maculilabris* and *S. forbesii*. The snake was of special interest, as no species of the genus *Simotes* had hitherto been previously known to occur eastward of Java.

Chemical Society, June 21.—Dr. W. H. Perkin, president, in the chair.—The following gentlemen were elected Fellows:—G. S. Bowler, C. Beringer, T. H. Coleman, A. Esilman, H. E. Harrison, C. Hulke, H. Heap, B. Hobbs, C. T. Heycock, W. J. Livingston, B. P. Lascelles, H. R. Mill, M. F. Purcell, J. E. Richardson, F. G. Roberts, W. R. Reffel, A. Smith, E. H. B. Stephenson, A. W. Soward, A. H. Samuel, D. Wilson, and R. Williams.—The following papers were read:—On evaporation in vacuo, by H. McLeod. The author has contrived several forms of apparatus, and in the present paper describes two. One in which the water was evaporated in a glass dish with ground top, at a temperature not exceeding 50°, 50 c.c. evaporated in two hours; a Körtings water pump was used to obtain the vacuum. Instead of the dish a test tube or a combustion tube may be employed. In the second form of apparatus sulphuric acid was allowed to trickle down the tube into which the aqueous vapour passed, and thus the use of a condenser was avoided.—Note on a hydrocarbon and some substitution derivatives from camphor, by H. E. Armstrong.—On the preparation of the pentathionates, by G. S. Shaw. The author has reinvestigated this subject, because Prof. Spring states in *Liebig's Annalen* that he was unable to obtain pentathionates by using the method described by V. Lewes. The author completely confirms the results obtained by Lewes, and has obtained beautifully crystalline salts in which the ratio of potassium to sulphur was as 2 atoms to 5. A note is appended to the paper by Watson Smith.—On the decomposition of ammonium nitrate;